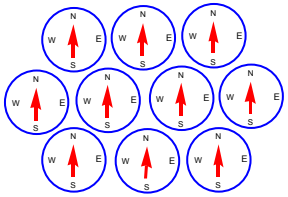
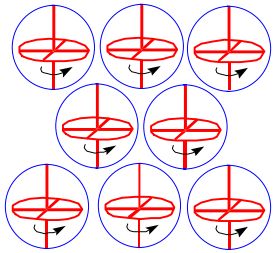
DMR9988438 Novel Electrooptic Materials Based on Dipolar Dielectrics: Molecular Compasses and Gyroscopes

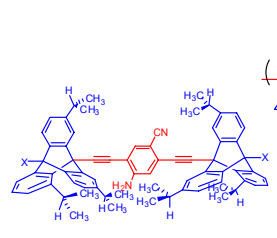
Synthesis, Crystal Engineering, Crystal Dynamics and Optics

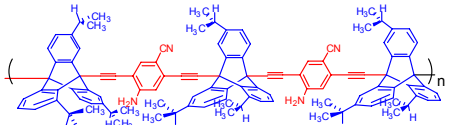
COMPASSES

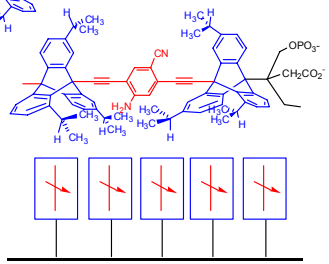


GYROSCOPES









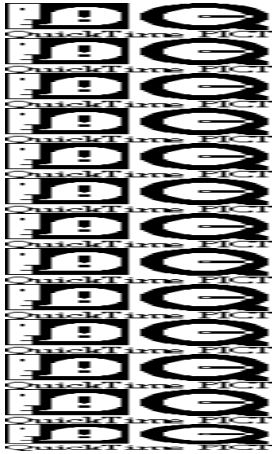
CRYSTALS

POLYMERS

Frictionless Rotation with Alkynes

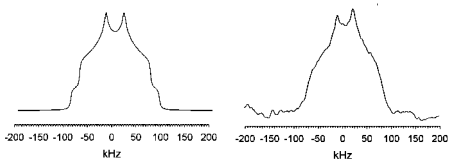
MONOLAYERS

Scientific Impact



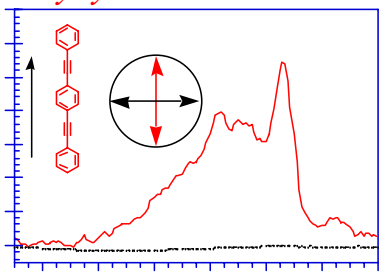
Current Record :
GHz Rotation in Crystals

$k_{rot} > 10^8$ Hz



QuickTime™ and a Animation decompressor are needed to see this picture.

Diethynylbenzene Dichroism



P.I., *M. A. Garcia-Garibay:*

J. Am. Chem. Soc. **2000**, *124*, 2398.
J. Am. Chem. Soc. **2002**, *124*, 4701.
J. Am. Chem. Soc. **2002**, *124*, 7719.
J. Phys. Chem. **2002**, *106*, 1551.

The goal of this research is to develop materials with functions that are based on the dynamics of solids.

Solids are designed with molecules that have polar groups which can rotate and reorient under the influence of external fields. Large shielding structures (i.e., trityls or triptycenes) linked by polar phenylene with alkyne bonds are essential in our design. We call them "Molecular Compasses and Gyroscopes"

It can be shown that molecular compasses crystallizing in certain symmetries will be spontaneously ferroelectric, e.g., the hexagonal 2D lattice.

Crystals, polymers, and monolayers built with molecular compasses and gyroscopes are expected to have properties analogous to those liquid crystals. Some should have faster response times.

Some Achievements:

1) We have worked out a concise and convergent procedure for the synthesis of moeluclar compasses and gyroscopes.

2) We have prepared several variants (much to be published).

2) We have established procedures to measure their dichroism in thin films and their rotational dynamics in solution (fluorescence anistropy).

3) We have established procedures to measure rotation in bulk solids. We have a structure that rotates at 300 K in GHz regime (ANIMATE).

4) We have carried out a photophysical evaluation of several related systems.

6) This work was featured in Chem.Engin. News July 8, 2002, p.32 and it has stimulated some speculation as a possible basis of 3D displays.

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Group Graduates in Academia:

—Asst. Prof. Shelli McAlpine
San Diego State Univ.
—Asst. Prof. Amy E. Keating,
MIT, Biology
—Asst. Prof. Alla. Gamarnik
Univ. Main
—Asst. Prof. Deniz Cizmeciyan
Mt. St. Mary Univ. CA
—Asst. Prof. Laura B. Sonnichsen
Parkland. College, IL
—Asst. Prof. Krista R. Motshiedler
LA Sierra College, CA
—Dr. Marcia Levitus *
(in the academic job market USA)
—Dr. Zaira Dominguez *
(in the academic job market, Mexico)

Collaborations with Chemists from Non-PhD Institutions

—Prof. Tina Choe
Loyola Marymount, CA
Solvent-Free Synthesis

—Asst. Prof. Deniz Cizmeciyan
Mt. St. Mary Univ.
Solid State NMR

—Asst. Prof. Beatriz Ruiz *
Trade Tech. College, LA
Photophysics

Minority Students In Ph.D. Program

—Carlos Godinez *
—Tinh A. Villareal Kuong *
—Jose Nunez *
—Luis Campos (NSF fellow) *

Undergrad. Students

—Mike Lo (UCLA)
—Kim Gordy (UCLA)
—Rebeca Ruiz * (UCLA)
—Heather Yonutas (Mt. S. M)
—Marino Rezendiz * (U. Utah)

** hispanic*

Other activities by the PI:
—Regional coordinator of the California LSAMP
—Graduate Recruting at UCLA
—Center for Academic and Reaearch Excellence (UCLA)
—Curriculum Development (UCLA)

With NSF as the main source of support, the PI has been able to create and maintain a very supportive environment for science education at a highy competitive level.

The PI's research is highly interdisciplinary and his group research enjoys international recognition in the fields of physical organic and solid state chemistry.

The above factors have combined to make graduate sudent recruiting exceedingly successful. The PI has attacted an unusually high proportion of extremely talented women and minority students.

ALL former female graduate students and postdocs have moved on to academic positions. Several group undergraduates went on to Graduate Programs in the country.

With the help of visitors from Suthamerica and productive contacts with Cal State LA and Cal State Dominguez Hills Universities, the PI has recently attracted several minority students to his group.

The PI supports colleagues and students from neighboring instutions with no PhD programs. Dr. Tina Choe is on a Sabbatical for one year as a ROA fellow. Drs. Cizmeciyan and Ruiz Silva come to UCLA to run experiments.

The PI is heavily involved in curriculum endeavors. He is a co-author of the current freshman and sphomore organic curriculum at UCLA.

The PI's group has hosted high school students, giving them lab tours and general lectures.

The PI has given invited lectures at the SACNAS national meeting and participated as a judge at the undergraduate Science fairs at UCLA and the California State-Wide LSAMP Conference.

The PI is a mentor in the UCLA Materials Creation Training IGERT Program.